Diet transition and wellbeing: challenges and prospects for food systems

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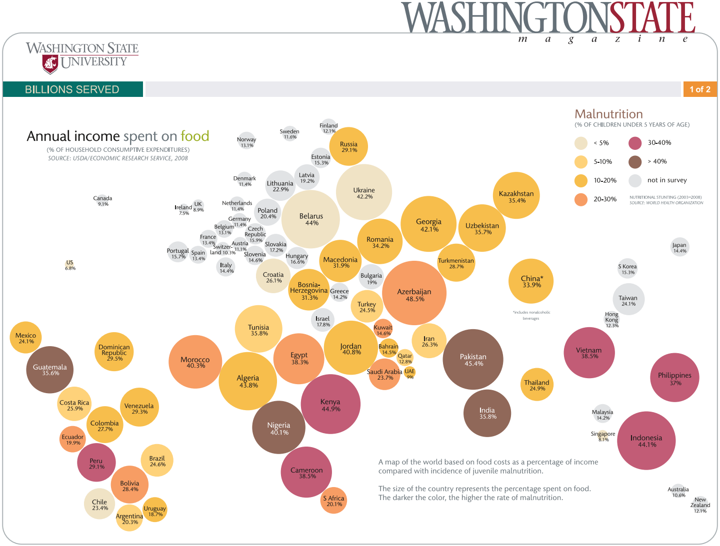
Food: a large budget share for consumers

Table : Food, Beverages and Tobacco budget share (2005)

Countries	Budget share
Low-income	48.5
Middle-income	31.1
High-income	20.4

Source: Worldbank

Food: a large budget share for consumers



Road Map

- Where we are ? Health, environment
- Why we are here? Income changes / Technological change
- What to do ? Public intervention requested
- Research needs and new challenges

Diet an important risk factor for NCDs

Leading risks factor causes of DALYs

Low-income countries		High-income countries	
Risk factor	% DALYs	Risk factor	% DALYs
Childhood underweight	9.9	Tobacco use	10.7
Unsafe water, hygiene	6.3	Alcohol use	6.7
Unsafe sex	6.2	Overweight and obesity	6.5
Suboptimal breastfeeding	4.1	High blood pressure	6.1
Indoor smoke from fuels	4.0	High blood glucose	4.9
Vitamin A deficiency	2.4	Physical inactivity	4.1
High blood pressure	2.2	High cholesterol	3.4
Alcohol use	2.1	Illicit drugs	2.1
High blood glucose	1.9	Occupational risks	1.5
Zinc deficiency	1.7	Low F&V intake	1.3

Source: WHO, 2009

Disability Adjusted Life Years (DALY)= Years Life Lost Disability (YLD) + Years of Life Lost (YLL)

DALY rate attributable to individual dietary risks in 2017 (undernutrition and obesity not included)

Source: Global Burden of Disease Study, The Lancet, 2019.

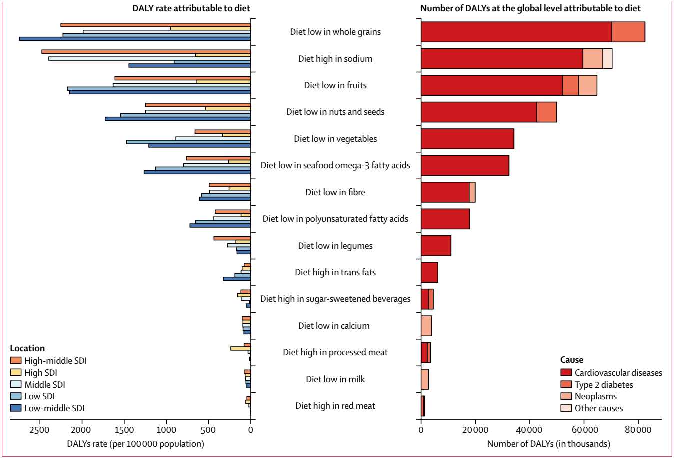
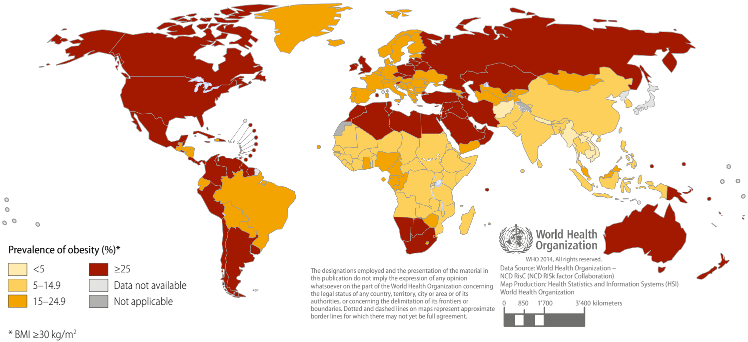


Figure 3: **Number of deaths and DALYs and age-standardised mortality rate and DALY rate (per 100 000 population) attributable to individual dietary risks at the global and SDI level in 2017**
DALY=disability-adjusted life-year. SDI=Socio-demographic Index.

Age-standardized prevalence of obesity in adult women ($BMI \geq 30$ kg/m2), 2014

Source: WHO Global status report on NCDs, 2014.

Fig. 7.2 Age-standardized prevalence of obesity in women aged 18 years and over ($BMI \geq 30$ kg/m^2), 2014



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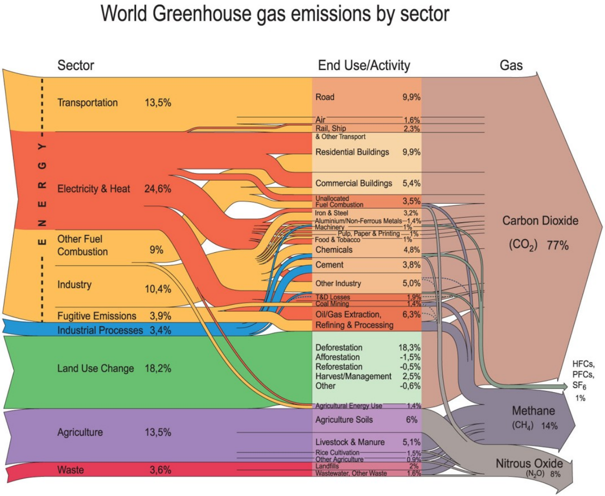
No country is experiencing a decrease in obesity rate

Diet - Health: Sum-up

- Increase in obesity rate
- Diet as an important risk factor for NCDs
- Priorities that might differ between countries / group of countries
- Need to evaluate the health impacts of deficiency/excess of nutrients (food groups) intakes at a more detailed level
- Large social inequalities wrt NCDs / Obesity (not shown)

Greenhouse gas emissions by sector

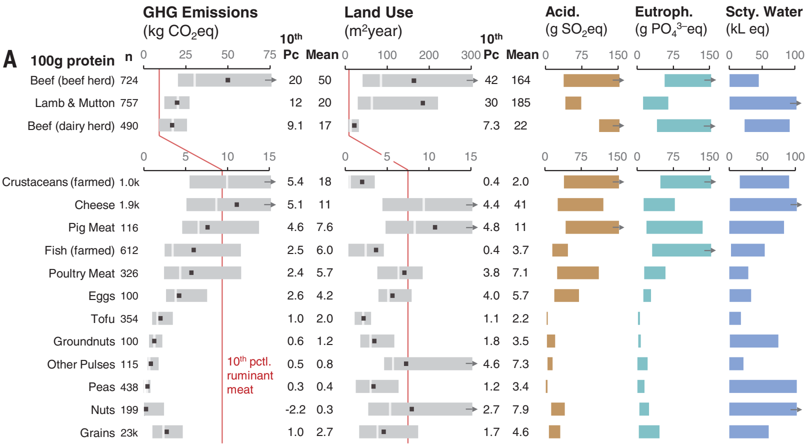


All data is for 2000. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41 755 MtCO_2 equivalent. Land use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

Source: World Resources Institute, Climate Analysis Indicator Tool (CAIT), Navigating the Numbers: Greenhouse Gas Data and International Climate Policy, December 2005; Intergovernmental Panel on Climate Change, 1996 (data for 2000).

GHG emissions of the food chain

- Food chain: 15 to 30% of GHG emissions of the EU member states. Most at the agricultural level (50 to 60%), mainly N_20 (soils, livestock), and CH_4 (ruminants).
- Agricultural sector: 10% of EU GHG emissions.
  - Animal production: 5% (direct) + part of 5% from crop production
  - Animal production including feed imports and ILUC : > 80% of EU emissions from agriculture
- Issues:
  - LCA versus accounting methods
  - Time horizon (N_20 and CH_4 equivalent in CO_2)



Source: Poore and Nemecek, 2018.

Greenhouse gas emissions from animals in the EU

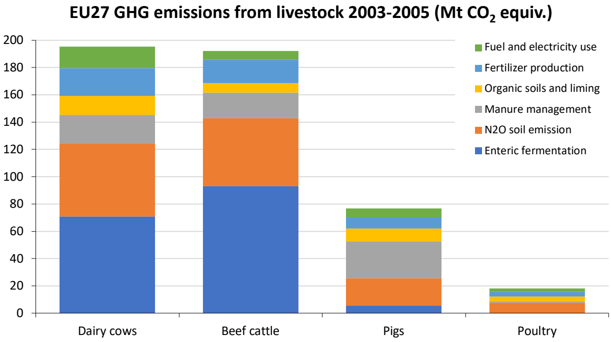


Figure 5. Total GHG emissions from livestock in the EU27 for the period 2003-2005 using the MITERRA-Europe model (adapted from Lesschen et al., 2011)

Meat production: Pig = 50%, poultry = 30%, and Beef= 20%

Meat consumption: trends

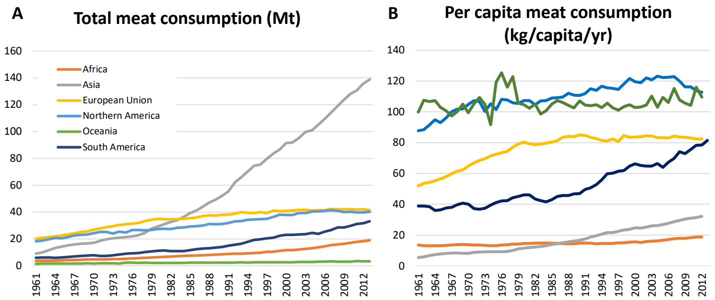


Figure 1. A) Total meat consumption, for selected world regions between 1961-2012; B) Per capita consumption, same regions between 1961-2012 (data source: own figure, data from FAOSTAT)

Source: RISE Report, 2018.

Other environmental impacts

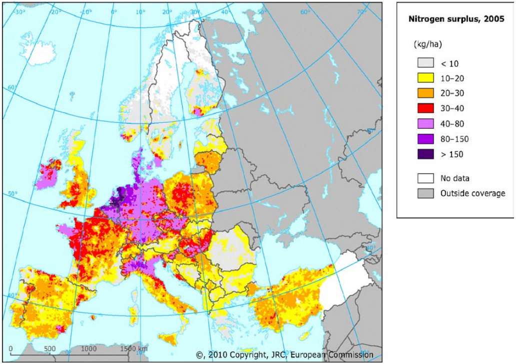


Figure 6. Nitrogen surplus in kg per hectare of agricultural land in the EU27 in 2005 (Source: EEA, 2010)

- Water pollution
- Air pollution
- Impact on biodiversity

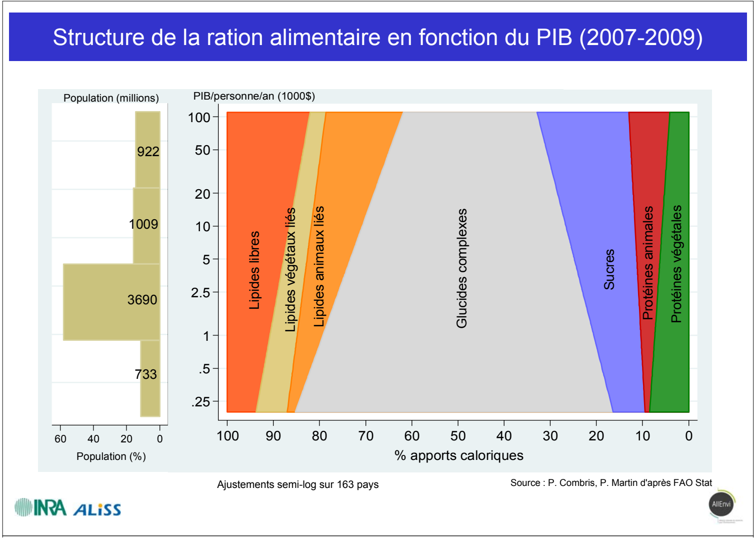
Diet - Environmental impacts: Sum-up

- Large environmental impacts of the food chain
- Diet composition matters: share of animal products (and type of animal products) in the diet ('quantity' effect)
- Production techniques also matter ('intensity' (per-unit) effect)
- Increase in meat consumption as a global threat for the environment
- **Inter-related issues as changes in the environment (climatic change for example) also affect human health**

Why we are here?

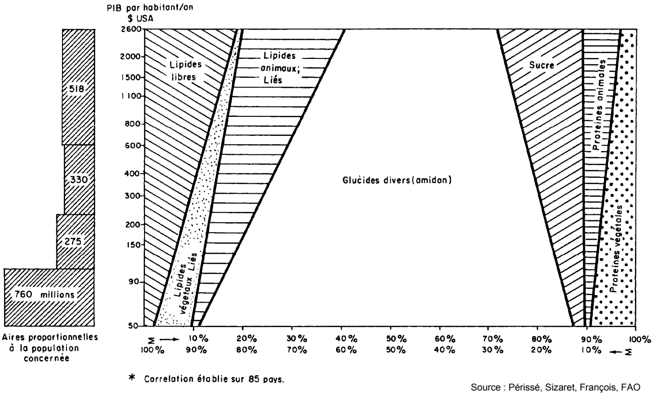
Role of incomes and technological change

Diet transition and income



50 years before: rather identical relationship

Structure de la ration alimentaire en fonction du PIB (1960-1963)



Source : Périssé, Sizaret, François, FAO

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Diet transition and income: Sum-up

- Last fifty years: same relationships between nutritional characteristics of diets and income
  - increase in animal products consumption
  - increase in fat intakes (free fat and animal fats)
  - increase in simple carbohydrates intakes
  - decrease in complex carbohydrates intakes
- **Most of the world population is still at the beginning of the nutritional transition**
- Global threat for the environment

Obesity as a consequence of technological change

Weight = Balance between calories In and calories Out

Growth in obesity as a function of technological change
Philipson and Posner (1999); Lakdawalla et al. (2005); Lakdawalla and Philipson (2009).

Technological change has

- Lowered the cost of consuming calories: lower real price of food
- Raised the cost of expanding calories: less physical expenditure of calories per hour worked

Why an increase in obesity? A simplified model

- Standard microeconomic model of the consumer
  - Weight function $W(F, S)$ (food intake (F) and calories expenditures (S))
  - Ideal Body weight: Utility is $U(W(F, S), F, C)$ **Utility is non monotonic in weight (Inverted U-shape)**.
- Consumer maximises utility under a budget constraint ($C + pF \leq I$)
- FOC is thus $U_W W_F + U_F = pU_C$
  - A decrease in the price of calories has a positive effect of weight ▸ Figure
  - Beyond some weight, the utility loss from gaining weight is larger than the 'joy to eating'.
  - **If marginal dis-utility of weight gain is higher for larger incomes then we get an Inverted U-shaped weight income profile**
  - If true, richer people are less obese

Implications of the model

- **Obesity as a side effect** of 'welfare-improving' technological change
- Difficulty of improving welfare by rolling back obesity to earlier levels

Are these changes still welfare improving ?

- Technological change also generates large 'externalities' (water pollution, pesticide residues, GHG, health related, ...)
- IS IT STILL WELFARE IMPROVING?
  - Social cost of obesity, France: €20 Billion 2016 as compared to €150 billion expenditures
  - External costs of food in UK as high as food expenditures (Fitzpatrick and Young, 2017)
  - Social cost of GHG: 700 Mt CO2eq/ year in the EU. €50 - €100 /t
  - Cost burden of endocrine disrupting chemicals: controversies (Trasande, 2015; Bond and Dietrich, 2017)

Consumer versus supply responsibility

- Huge changes in food supply chain is well documented (e.g. Reardon for developing countries): from unprocessed fresh products to packaged and processed ready-to-eat or ready-to-heat
- Evidence of 'hedonic over-eating' when brain reward system overrides the metabolic signals (cf. Yu et al, 2015)
- Food choices might be linked to a change in the food environment that has modified preferences
- Only few studies on the causal effects
  - Cockx et al. 2017: The growth of unhealthy food consumption with urbanization is largely linked to rising incomes rather than to urbanization per se.
  - Dubois, Griffith, Nevo 2014. The food 'environment' plays a significant role. Details
  - Alcott et al., 2019. Preferences as the main explanation of differences in diet quality between income quartiles Details

Synthesis

- Changes in income as a major source of diet transition. Still at the beginning of the process
- Numerous analysis on the changes of diet / the impact of changes but lack of analysis of causal effects
- Obesity, low quality diets as a side effect of technological change in the food chain
- Interlink between food environment / preferences / income changes
- Are these changes still welfare improving given the high external costs?
- Some sort of equilibrium with a large number of external costs: How to move from this equilibrium ?

What to do ?

Public intervention requested

What to do ?

- Changes in consumer demand: more local food, less processed, less additives, increased demand for organic products,
- Local initiatives from producers : direct sales including internet 'platforms', local brands, ...
- Actions that might remain marginal and will not change the core of the market
- Many market failures requesting public intervention

Why intervention is needed ?

- Health : Evidence of association between diet and incidence of non-communicable diseases
  - Associated health care costs that are borne by taxpayers (internalities)
  - Delayed impact and difficulty to have the 'correct' knowledge. Rationality bias. Room for paternalistic policies (Donoghue and Rabin, 2006; Cremer et al. 2012)
  - Difficulties to monitor nutrient intake (Griffith et al., 2010); Self control problem in managing food intake
- Health: pesticides, additives
- Environment: mainly externalities that need to be corrected
- Emerging issue: impact of the environment on health (does not change the need for intervention but might change the level needed)

How to intervene

Will be developped by Daniele Moro

- Instruments regulating how to produce .... focus on one 'goal'
- Instruments whose aims is to modify diets will impact multiple dimensions ... **Convergence/ Divergence**
- **A key issue which is overlooked : How firms react to policies**

Difficulty: multiple goals Convergence / Divergence

(Will be developped by Jennie mc Diarmid. Some key results from an economic perspective).

- Tax based on GHG content (Carbon tax) might have **negative health impact** (favor energy dense products)
- To have positive impacts on both dimension (GHG / Health) tax design should integrate elements from nutrition
- **Taxing products with high GHG content / Subsidizing F and V** Springmann et al. 2016; Doro and Réquillart 2018.
- **Convergence** between climate change and health goals is **possible but not granted**.
- For a given policy, convergence in some countries / divergence in some others (Irz et al, 2019).
- In Cost Benefit Analysis, **health impacts are likely to dominate** GHG (and acidification) impacts.

Why integrating firms reactions to policy is a key issue

- Price response to a tax policy
  - Soda tax in France. Pass through depends on the design of the tax (Bonnet and Réquillart, 2013)
  - Ad valorem: about 0.7 ; ignoring the price effect leads to **overestimating** the impact by 30%
  - Excise tax: about 1.2 ; ignoring the price transmission leads **underestimating** the impact by 20%
- Price response to a labeling policy
  - Dairy desserts market. Extending a mandatory label on the fat content (Allais et al., 2015)
  - Taking into account price response of firms **lowers** the potential impact of the policy (by 1/3).
- Price response to a ban on advertising
  - Potato chips market. Banning advertising on this market (Dubois et al., 2018)
  - Taking into account price response of firms **lowers** the potential impact of the policy (by 1/3).

Research needs / Challenges

- Assessing the multiple impacts of various regulations
- Focusing on intra-categories changes
- Lifestock sector issue
- Ultra Processed Food

Assessing the multiple impacts of various regulations

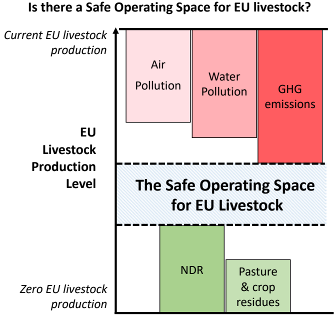
- n dimensions: Health, GHG, Land use, environment,
  - Linking models (economics, environment, epidemiology)
  - Develop consistent database
- What are the welfare impacts? Cost benefit Analysis
- Economics: Supply and demand response (frequently only demand)
- Limits (economic models):
  - Focus on inter-categories (small number of food items; potential effect is 'large' but changes are 'difficult')
  - Address heterogeneity of situations
  - Poor representation of processing / retailing activities

Focusing on intra-categories changes

- Intra-categories changes are easier but smaller impact 'per-unit'.
- More detailed models integrating firms strategy (empirical IO models)
- Better representation of consumer choices
- Limits:
  - Focus on at home consumption whereas out of home consumption is rising
  - Focus on given group(s) of products: rest of the diet remains constant.
  - How to integrate intra-categories changes in a larger framework (inter-categories changes)

Lifestock sector issue

- Lifestock sector : outside of durability boundaries (in particular GHG but also nutrients flows, ..)
- An interesting attempt : Safe Operating Space (RISE report, 2018)
- How to 'organize' the transition. Is the wine sector an interesting example ? Lower quantity / Higher quality



(Note: this figure's purpose is to illustrate the SOS concept, it's not data based)

Ultra Processed Food

- Emerging evidence on a possible adverse effect on health
  - Correlation with obesity at the country level (Monteiro et al. 2013, see also Popkin, 2017)
  - Recent study, more than 100,000 consumers. Correlation obesity, some NCDs, (Touvier et al., 2019)
  - Lot of uncertainty: rough classification, what explains the correlation (energy density, additives, processing, ...)

- Might significantly impact the demand and as a consequence the whole food chain

- What are the alternatives?
  - Going back to the kitchen ??
  - Make it healthier, new recipes, .. ?
- Need to better understand how consumers preferences evolve and how consumers adopt (or not) innovations

Thank you !

for your attention

Additional slides
Figure to illustrate Lakdawalla model
Table from Dubois et al. Graph from Alcott et al.

An illustrative Figure

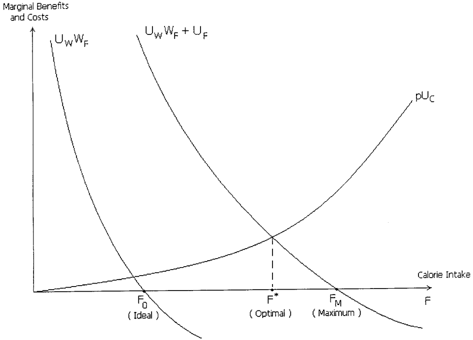


Figure 1: Ideal, Optimal, and Maximum Weight

Understanding the role of the environment and preferences to explain food purchases differences

- Dubois, Griffith, Nevo, AER, 2014.
- Structural demand model of food purchases estimated with individual data in three countries
- Counterfactual exercise to explain differences in purchases due to the environment and preferences

	Env / Pref	American in Paris		American in London	
		Calories	Share	Calories	Shares
Prices	Env	< 0	Y	> 0	Y
Attributes	Env	$\simeq 0$	Y	< 0	$\simeq 0$
Category	Env / Pref	$\simeq 0$	Y	$\simeq 0$	Y
Nutrient Pref	Pref	$\simeq 0$	$\simeq 0$	< 0	$\simeq 0$

- Environment (prices, attributes) plays a significant role
- Interaction between preferences, prices and attributes explains cross-country differences

US Food deserts: Preferences as the main explanation of differences in diet quality between income quartiles

Figure 9: **Predicted Health Index for Each Income Group**